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GRAIN YIELD AND GRAIN-MILLING QUALITY AS AFFECTED BY RICE BLAST DISEASE (*Pyricularia grisea*), AT MY THANH NAM, CAI LAY, TIEN GIANG

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ABSTRACT

Grain yield and grain milling quality as affected by blast diseases (Pyricularia grisea) were observed in fields where two systems of cultural practices were applied. The innovational techniques were to apply recommended techniques compare to farmer's practices. The experiment was laid out in total of 15 farmers' fields. OM3536 is a good grain quality variety but susceptible to blast disease. Neck blast infection was sprayed by fungicide "tricyclazole" 20 WP, with dosage of 1 kg ha^{-1}. Results indicated that serious damage due to neck blast was in the farmers' fields applied old practices (high planting density and high nitrogen application). Fungicide (tricyclazole) sprayed different times at the panicle emergence stage in the old practice plots to control neck blast, but was not effective, while in recommended practices fungicide sprays to control neck blast was effective with less severity of neck blast. Loss in grain yield was from 38.21% to 64.57%. Percentage of reduction from 3.12% to 11.27%, and from 3.67% to 5.07% of head rice and 1000 grain weight, respectively.

Key words: Grain yield, Grain milling, *Pyricularia grisea*, Tricyclazole

INTRODUCTION

Rice blast disease caused by *Magnaporthe grisea* is the important disease of rice worldwide causing 11-30% loss in yield and reducing grain quality in many rice-growing areas. Rice is the staple crop of two thirds of the human population, which is expected to increase rapidly in the future, but mostly in rice-consuming countries. Thus, rice blast disease is a significant constraint to global food security and agricultural trade (Leong 2004).

Neck blast may cause a complete loss in grain yield of susceptible varieties in case the control is not yet on time. In dry season of the Mekong Delta of Vietnam, rice blast disease often causes outbreak in February, due to low night temperatures of 22 to 23^{o}C and long dew appearance during the day. In August of wet season, the heavy damage of blast disease is due to light drizzling all days in many areas (Kim 1993). High planting density and excessive nitrogen application increase the number of host plants and create more humidity within rice canopy that is conducive for blast occurrence. Many blast lesions appeared as early as at the rice seedling stage when seed rate increased from 80 kg ha^{-1} to 120 kg ha^{-1} (Fomba, 1994). Management of rice blast needs to integrate all available techniques including resistant varieties and proper cultural practice followed by timely application of fungicide (Chang 1994).

The objectives of this study are to find out the effect of rice blast disease on grain yield and grain-milling quality of two cultivation practices (conventional *versus* innovational) based on levels of seeding rate, nitrogen fertilizer application and fungicide spraying.

MATERIALS AND METHODS

The experiment was laid out on farmers' fields at My Thanh Nam village, Cai Lay district, Tien Giang province, where farmers are applying innovational technologies for rice cultivation. A total of 15 farmers' fields was participated to conduct experiment. OM3536, a good grain quality and short growth duration of 85-90 days but susceptibe to blast disease was selected for the experiment. Farmers grew rice applying both cultivation practices including different treatment for controlling neck blast in their fields.

For innovational practice, using recommended techniques, certified seed was used with seeding rate 100 kg ha^{-1}. Row planting was applied using drum seeder. Nitrogen fertilizer was applied based on leaf color chart (LCC) to reduce excessive use of nitrogen that would create problems of pests and diseases. The average dose of fertilizers used was of 73.3-53.3-39.6 kg NPK ha^{-1}.

For farmer's practice, high seeding rate of 200 kg ha^{-1} by broadcasting and high fertilizer doses of 133.3-53.3-39.6 kg NPK ha^{-1} were used. Neck blast infection was controlled by fungicide Lim (tricyclazole) 20 WP, with dosage of 1 kg ha^{-1} per spray with the following treatments:

1. One spraying at 3% of panicle emergence;
2. Two spraying at 3 and 80% of panicle emergence;
3. Three spraying at 3, 80 and 100% of panicle emergence
4. Control 1 (no fungicide);

Water level and weeds were managed throughout crop season. Leaf blast was controlled by spraying twice with fungicide, *ie*. Lim (tricyclazole) 20 W at 35 and 45 DAS. Sowing date is starting from 22 November to 28 November 2005.

Physiological characteristics and disease parameters were recorded in five different growth stages *i.e.* maximum tillering, panicle initiation, booting, flowering and mature stage. The parameters collected were: number of tillers, plant height, and chlorophyll content measured by using chlorophyll meter Minolta SPAD 502, light intensity below rice plant canopy (lux), disease incidence and disease severity (IRRI 1996). Grain yield was taken at the mature stage about 5 days before harvesting. Rice grain was analyzed for grain quality such as brown rice, milled rice, head rice, broken rice, chalky kernel and 1,000-grain weight (g) at the laboratory of NCVESC. Microclimate within rice canopy was measured 3 times per days from 6:00 AM, 11:00 AM and 6:00 PM using Humidity Temperature Meter.

All data collected were statistically analyzed using SPSS program for Windows.

RESULTS AND DISCUSSIONS

Dry season in the Mekong Delta is suitable for rice crop to produce the highest grain yield compared with wet season crop. Nevertheless, the weather of this season was also very conducive for rice blast damage.

Observation in rice farmers' field applying innovational techniques where less fertilizer was applied at rate of 73.3-53.3-39.6 kg NPK/ha and sprayed three times of fungicide: to control leaf blast disease at 35 days after sowing (DAS) and 45 DAS and neck blast at panicle emergence. Results obtained from farmers' field showing that grain yield was higher due to less blast disease incidence. Meanwhile, serious damage was found in the farmers' field applied old practices (broadcast at 200 kg ha^{-1} and excessive dose 60 kg N ha^{-1}). The plots were completely damaged at the flowering stage by neck blast. Furthermore there were two plots of missing data due to lodging at the mature stage. Hence, the effect of panicle blast on grain yield and quality was compared between twenty-two plots applied the traditional practice, twenty-eight plots applied innovational technique.

Results from the microclimate measurement above rice canopy indicated that the favorable temperature (^{0}C) and RH (%) for blast disease progress curve were 26.73 ^{o}C and 92.17 % and within rice plant canopy were 25.26 ^{o}C and 97.36 %. In addition, heavy dew droplets were observed on leaf surface from 17:30 pm to 7:00 am next day.

Results from the experiment also indicated that at 30DAS, 40DAS and 50DAS, the number of tillers was significantly higher and the light intensity below rice canopy was significantly lower in the traditional plots. Similarly, chlorophyll content in the old practice plots was also higher and significantly different as compared to the innovational plots (Table 1).

Table 1. Tillers, plant height, chlorophyll content leaves, light intensity below rice plant canopy at different stages of two different systems of rice cultivation (n=30)

Variable	Unit	Applying old practice plots [a]	Applying modern technique plots [b]	T test
Tillers at 20DAS	tiller/m^2	1,099.47	801.11	**
Tillers at 30DAS		1,043.69	791.29	**
Tillers at 40DAS		809.02	630.00	**
Tillers at 60DAS		654.00	537.16	**
Plant height at 20DAS	cm	51.67	45.96	**
Plant height at 30DAS		64.59	60.78	**
Plant height at 40DAS		78.97	80.33	**
Plant height at 60DAS		104.36	107.61	**
Chlorophyll content at 30DAS	SPAD values	34.74	33.13	**
Chlorophyll content at 40DAS		33.54	31.99	**
Chlorophyll content at 50DAS		33.01	30.85	**
Light intensity at 30DAS	lux	552.56	1,755.33	**
Light intensity at 40DAS		471.00	1,281.56	**
Light intensity at 50DAS		374.67	703.67	**

[a] Broadcast at 200 kg ha^{-1} and extra 60 kg N ha^{-1}; [b] seeding rate 100 kg ha^{-1}, drum seeder and using LCC for applying nitrogen fertilizer; (**) significantly different at the 1% by T-test

Onset of blast lesion on foliar was found at early as 20DAS. Blast damaged curve increased at 30DAS, 40DAS and 50DAS. In addition, collar blast disease also occurred at 40DAS. Significantly increased of leaf and collar blast found in the plots applied conventional practice compared to those applied innovation technique (Table 2).

Table 2. Leaf and collar blast damaged curve at different growth stages of applied conventional compare to innovation technique plots (n=30)

Variable	Unit	Applying old practice plots [a]	Applying modern technique plots [b]	T test
DI of leaf blast at 20DAS [c]	%	0.57	0.50	*
DI of leaf blast at 30DAS [c]	%	4.07	1.45	**
DI of leaf blast at 40DAS [d]	%	72.39	39.11	**
DI of leaf blast at 50DAS [d]	%	65.99	31.97	**
DS of leaf blast at 20DAS [c]	%	0.51	0.50	*
DS of leaf blast at 30DAS [c]	%	1.81	0.69	**
DS of leaf blast at 40DAS [d]	%	43.08	24.83	**
DS of leaf blast at 50DAS [d]	%	41.72	20.65	**
DI of collar leaf blast at 40DAS [c]	%	2.99	0.87	**
DI of collar leaf blast at 50DAS [c]	%	18.12	1.79	**
DS of collar leaf blast at 40DAS [c]	%	1.53	0.60	**
DS of collar leaf blast at 50NSS [c]	%	10.42	0.96	**

[a] Broadcast at 200 kg ha^{-1} and extra 60 kg N ha^{-1}; [b] seeding rate 100 kg ha^{-1}, drum seeder and using LCC for applying nitrogen fertilizer; [c] data transformed to $(x+0.5)^{1/2}$; [d] data transformed arcsine before T-test; (**) significantly different at the 1% by T-test.

Disease incidence (DI) and disease severity (DS) of the old practice plots were significantly higher compared to those of the applied innovational practice plots. In this experiment, the collar blast was infected heavily in farmer's practice plots, especially at 50 DAS. DI and DS from the farmer and the recommended practices were 12.18% and 10.41% compare to 1.79% and 0.96%, respectively. Loss in yield was found more affected if the flag leaf was collapsed. Neck blast incidence and severity at the harvest were shown in Table 3.

Table 3. Disease incidence (DI) and disease severity (DS) of panicle blast at seven days before harvest

No.	Treatments[a]	DI panicle blast[b]	DS panicle blast[b]
1	Tricyclazole 20% one spray	52.33 c	35.95 c
2	Tricyclazole 20% two sprays	52.06 c	34.97 bc
3	Tricyclazole 20% three sprays	42.86 b	29.54 b
4	Control (no fungicide)	74.79 d	61.62 d
5	Control 2 (innovational technique)	14.07 a	10.58 a
	Computed F	**	**
	CV (%)	31.84	27.92

[a] Treatment no. 1 to no. 4 broadcast at 200 kg ha^{-1}, extra 60 kg N ha^{-1} , and spray Tricyclazole 20% control panicle blast disease; treatment no. 5 seeding rate 100 kg ha^{-1}, drum seeder, using LCC, and spray Tricyclazole 20% control panicle blast disease; [b] data transformed to arcsine before ANOVA; mean in a column followed by different letters show significant difference at level by DMRT 5%.

Results in Table 3 showed that treatments No. 1, No. 2 and No. 3 had significantly lower DI and DS of panicle blast compared to treatment No. 4 (control, no spray). However, the average of DI and DS of panicle blast were very high (49.8% and 34.48%) as compared to 14.07% and 10.58% of the innovational practice applied plots. These situations may be due to high seeding rate of 200 kg ha^{-1} and high nitrogen dose (133.3 kg N ha^{-1}) which created favorable conditions for blast disease development. Fungicide (tricyclazole) sprayed different times at the panicle emergence stage in the old practice plots to control neck blast, but was not effective compared to applying the innovational measure such as low seeding rate (100 kg ha^{-1}), using LCC for applying nitrogen fertilizer (76.3 kg N ha^{-1}) and good water management.

Table 4. Effect of panicle blast disease to grain yield, yield, 1,000-grain weight (g) and rice grain-milling quality

No.	Treatments[a]	Grain yield (t/ha)	Brown rice (%)	White rice (%)	Head rice (%)	1,000-grain wt. (g)	Broken rice (%)	Chalky kernel (%)
1	Tricyclazole 20% one spray	2.64 b	80.53 b	70.97 b	46.74 ab	22.64 a	24.19	1.08
2	Tricyclazole 20% two sprays	2.98 b	80.42 b	70.88 b	47.13 ab	22.47 a	23.75	0.98
3	Tricyclazole 20% three sprays	3.54 c	80.58 b	71.11 b	48.73 b	22.80 a	22.38	1.00
4	Control 1 (*no fungicide*)	2.03 a	79.69 a	69.70 a	44.63 a	22.58 a	25.07	1.08
5	Control 2 (innovation technique)	5.73 d	80.56 b	71.09 b	50.30 b	23.67 b	20.79	0.90
	Computed F	**	**	**	**	**	ns	ns
	CV (%)	24.18	0.6	2.03	12.09	3.69	23.28	37.13

[a] Treatment no. 1 to no. 4 broadcast at 200 kg ha^{-1}, extra 60 kg N ha^{-1}, and spray Tricyclazole 20% control panicle blast disease treatment no. 5 seeding rate 100 kg ha^{-1}, drum seeder, using LCC, and spray Tricyclazole 20% control panicle blast disease; mean in a column followed by different letters show significant difference at level by DMRT 5%.

Table 4 showed that in the treatment No.1, No.2, and No.3 of the old practice plots, which had the same seeding rate and level nitrogen fertilizer, spraying tricyclazole 20% increased grain yield compared to the control (no fungicide). In the treatment No.3 with three sprays of tricyclazole 20% gave better grain yield (3.54 t/ha) as compared to the treatment No. 1 and No. 2 (2.64 t/ha and 2.98 t/ha), respectively. In this experiment, grain yield of the plot applied the innovational practice was the highest (5.73 t/ha). These results indicated that in the situations where high seeding rate and excessive nitrogen fertilizer application the yield still reduced significantly from 38.21% to 64.57%, even spraying fungicide to control panicle blast disease.

Effect of panicle blast on rice grain quality was analyzed. The percentage of brown rice and white rice of the treatments sprayed with tricyclazole 20% were higher than the control, which was not prayed. The percentage of head rice of the treatments No. 3 and of those from modern practice-applied plots were significantly higher compared to the control without spraying fungicide at 1% level of significance. In treatment No.5 (modern practice plots), 1,000-grain weight was only the highest and significantly different compared to the other treatments. The percentage of broken rice and chalk kernel were not significantly different among treatments.

DI and DS of panicle blast were negatively correlated with the yield and percentage of brown rice, white rice, and head rice. DI and DS of panicle blast was negatively correlated with grain yield (r = -0.85** and -0.82**); respectively. Similarity, DI and DS were lower correlation with the percent of brown rice, white rice and head rice (r = -0.31** and -0.47**).

Analysis using contrast test between two levels of seeding rate and nitrogen dose, effect of rice blast disease on grain yield and rice grain-milling quality were 49.08% and 33.49% in the old practice plots compared to 14.57% and 10.58% in the innovation plots. Percentage of head rice, 1,000 grain weight, and grain yield of the innovation plots was higher and significantly different as compared to the traditional plots.

CONCLUSIONS

Blast disease was seriously damaged on the conventional plots compared to the innovation plots. Hence, there were 26.66% of old practice plots, which were completely destroyed by neck blast at the flowering stage. Fungicide sprayed after panicle emergence could not control neck blast damage. Meanwhile, less blast disease, high grain yield and good milling quality were found on the innovation practice-applied plots. Effect of fungicide sprays was also better in the plots with low seeding rate and less nitrogen fertilizers used. Loss in grain yield due to neck blast was from 38.21% to 64.57%. Percentage of reduction of head rice from 3.12% to 11.27% and 1,000-grain weight from 3.67% to 5.07% was due to neck blast.

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Ảnh hưởng của bệnh cháy lá đến năng suất và chất lượng gạo tại Mỹ Thạnh Nam, Cai Lậy, Tiền Giang

Thí nghiệm ảnh hưởng của bệnh cháy lá (*Pyricularia grisea*) đối với năng suất và phẩm chất hạt được thực hiện trên cánh đồng cao sản tại xã Mỹ Thành Nam, huyện Cai Lậy, Tiền Giang. Thí nghiệm thực hiện trên ruộng nông dân: gồm ứng dụng các tiến bộ kỹ thuật mới trong sản xuất so với tập quán sản xuất cũ. Trong điều kiện thời tiết thuận lợi của vụ đông xuân (ban đêm nhiệt độ thấp, ẩm độ cao và có nhiều sương mù), đối với giống lúa OM3536 (giống ngắn ngày, chất lượng cao và nhiễm nặng bệnh cháy lá), trong khi đó ruộng sản xuất theo tập quán cũ: sạ mật độ cao (200 kg/ha), bón nhiều phân đạm (133,3 kg N/ha); bệnh cháy lá phát triển và gây hại nghiêm trọng. Kết quả cho thấy với phương pháp canh tác cũ, có 26,66% số lô ruộng bị rất nặng trước khi lúa trổ. Bệnh thối cổ bông đã làm giảm từ 38,21% đến 64,57% năng suất. Trong điều kiện thuận lợi cho bệnh phát triển, ngay cả việc sử dụng thuốc hoá học Tricyclazole 20% để phòng trị bệnh cháy lá vẫn không đạt hiệu quả cao. Ngoài ra, bệnh cháy lá còn làm giảm từ 3,12% đến 11,27% phần trăm gạo nguyên và giảm từ 3,67% đến 5,07% trọng lượng 1.000 hạt. Trong khi đó, việc ứng dụng các biện pháp canh tác mới đã được khuyến cáo như mật độ sạ vừa phải (100 kg/ha), sử dụng bảng so màu để bón phân đạm với liều lượng hợp lý (73,3 kg N/ha) và quản lý nước tốt; bệnh cháy lá gây hại không đáng kể, đồng thời việc sử dụng hoá chất Tricyclazole 20% để phòng trị bệnh cháy lá sẽ cho hiệu quả cao.